NEVADA GOLDFIELDS INC.

BARITE HILL MINE

PERMIT 852, ITEM 3

WASTE ROCK GENERATION POTENTIAL

Highway 221 and State Road 33-162

McCormick, South Carolina 29835

December 1991

TABLE OF CONTENTS

1.0 INTRODUCTION

As required in Section 3 of Barite Hill Mine Permit No. 852, a plan has been prepared to allow for the identification and disposal of potentially acid generating waste rock. The program includes a description of the sampling of the waste rock during mining, the analytical protocols to be used to establish if the waste has acid generating potential, and the means of disposal of the identified waste rock.

The purpose of the monitoring program will be to confirm the pre-operational assessment of the acid generating potential in the waste rock and permit active, day-to-day decisions to be made on how to handle and place waste rock during operations. While the plan focuses on the sampling of visually sulfitic rock, it also allows for continued evaluation of the acidification-neutralizing potential of the various rock types found within the planned pit areas. A log system for showing the final disposition of the identified waste rock is also included in the plan. The method which will be used to mitigate acid formation in waste rock is also addressed. It should be noted, that as further data is collected and confidence is gained in the reliability of the sampling and testing protocols being used, it may be possible to implement a simpler monitoring program which is equally protective of the environment as that proposed in this document.

The proposed monitoring program is divided into three parts:

- Sampling;
- Analysis and interpretation; and
- Reporting.

2.0 BACKGROUND

The pre-operational test program to identify acid generation potential in the waste rock has been described in three letters submitted to the SCLRC by D. P. Engineering, Inc. (DPEI) as follows:

- October 30, 1989: initial static, acid base accounting test data and their interpretation for the Main Pit and the Rainsford Pit;
- January 19, 1990: kinetic humidity cell test results and their interpretation; and
- March 1, 1990: acid leachate treatability study.

The salient data and conclusions described by DPEI in these letters can be summarized as follows:

- Based on the results of static acid generating potential tests and considering the relative quantities of the various waste rock lithological types to be mined, both the Main Pit and the Rainsford Pit waste rock materials have the potential to create acid in small amounts, if all the acid producing materials contained in the waste are reactive and capable of oxidation under ambient conditions;
- From humidity cell testing of three composite waste rock materials, comprising some of the samples used in the static tests, DPEI concluded that the waste rock from the Main Pit was unlikely to produce acid leachate in the long term, as these materials were hardly reactive during the test. However, there was a possibility that certain types of waste rock from the Rainsford Pit could produce acid locally as pH values in the humidity cell were still declining at the end of the test; and
- Mitigative measures, including the isolation of reactive materials within the dump area and provision of limestone in the base and toe of the dump, were to be included in the dump design to so that any acid generated by the waste rock would not impact the environment.

The letters are presented in the appendix for reference.

3.0 SAMPLING

A sampling program needs to generate enough samples to adequately characterize the waste, but not so many samples that it becomes a burden to the mine operator to implement the program. Focusing the testing on questionable rock (that containing visual sulfides), with periodic random sampling of the other waste rock is therefore the basis of the testing program. It has been established by the initial testing (October 30, 1989 letter from Don Poulter to Craig Kennedy) that at Barite Hill, only visually pyritic lithologies show a potential for acid production. Instead of sampling areas which are obviously completely oxidized and therefore have no acid producing potential, or setting up some random testing grid, the majority of samples will be taken from areas containing visible sulfides. Additional samples will also be taken periodically from other areas to ensure that the non-pyritic waste rock does not change and become acid producing.

A visual inspection of the drill hole cuttings by the mine geologist will determine the areas containing sulfitic minerals. Each discreet area, or minable block, will be considered separately as long as the area in question is at least 10'x10'x10' (the smallest block we are capable of mining). A minable block has no maximum size as long as it is contiguous . A composite sample will be collected from all drill holes in the block. The sample will weigh at least 500 grams. This amount of sample will allow for both static and kinetic testing, should they both be necessary.

Pyritic waste rock will be considered to be acid producing unless testing shows otherwise. This will allow for continued mining of waste even if testing is not completed by the time the waste needs to be moved. The acid producing rock will be disposed of in such a manner as to eliminate or reduce the production of acid drainage (as described in Section 4.0).

Non-pyritic waste blocks will also be randomly sampled to allow for the continued evaluation of the various rock types found within the planned pit. The number of samples will correspond to the size of the block as recommended in the BC AMD Task Force Draft Technical Guide, Volume 1, August 1989. (Figure 1)

4.0 ANALYSIS AND DISPOSAL OF WASTES

As described in the background to this program, Nevada Goldfields has determined that, on the basis of peroxide oxidizable sulphur and acid neutralization capacity comparisons, and humidity cell tests, many of the waste rock materials are not acid generating. However, these types of tests will be continued during operations, in order to allow correlation with the previous pre-operational database.

Analysis of samples from each block during mining operations will comprise the following:

Samples will be analyzed for reactive sulphur to determine acid generation potential (AGP) - by the peroxide oxidizable test protocol, and acid neutralization capacity (ANP) - by the acid titration method. If the sample ANP exceeds the AGP, both expressed in similar units of tons of calcium carbonate equivalent per kiloton of waste rock ($TCaCO_3$ equivalent/KT), then the material will be considered non-acid producing and may be placed on the waste dump, constructed with limestone underdrains, or used for construction purposes.

If, however, the material has an excess acid generation potential (AGP), it will be considered as potentially acid producing material. This material will either be backfilled into a pit and capped with a clay layer (preferred alternative), or will be isolated within the interior of the waste dump so as not to be in contact with the dump foundation or exposed in the face of the dump. If backfilling into a pit is planned, every effort will be made to immediately place the waste rock into the available area within the pit. The designated waste will be compacted by vehicle traffic, and capped with a clay layer. The backfilled pit will be graded to promote runoff away from the pit area, it will then be covered with a topsoil layer and be revegetated. If immediate space is not available within the pit, the waste rock will be stored beside the pit until space is available, this will be a temporary storage area. The waste will be stored in such an area for an absolute minimum time not to exceed one year. The temporary waste storage area will be constructed to minimize erosion. Drainage from this area will be constructed to channel runoff from the storage area into the pit for ultimate discharge through an NPDES point if required.

At this time, humidity cell tests are not being recommended to further characterize the waste AGP. The analysis described above is conservative, as more waste rock may be characterized as 'acid generating' by the procedures than would actually produce acid.

The current waste disposal plan is to stockpile all the

pyritic waste from both pits next to the Rainsford Pit until mining in the Rainsford is completed, currently scheduled for the third quarter of 1992. The pit will then be backfilled and capped. Topsoil will be added and the area revegetated.

5.0 REPORTING

A log and maps will be kept on site that indicate the area and depth of disposal of any acid producing waste material. The log will describe the method of disposal, for example: a 20'x20'x10' area, compacted and capped; and the maps will approximate where in the dump or pit the waste lies.

A Chain of Custody will be maintained on each sample so that the origin of each waste block, the results of any lab tests, and final placement of each block is known. The placement of the temporary waste stockpile at the Rainsford Pit will also be logged for further reference.

APPENDIX

D. P. ENGINEERING, INC.

7125 W. JEFFERSON AVE., SUITE 300
LAKEWOOD, CO 80235

TEL: 303-980-0679
FAX: 303-985-0439

March 1, 1990
Project No. 00701

South Carolina Land Resources
Conservation Commission
2221 Devine Street, Suite 222
Columbia, South Carolina 29205

Attention: Mr. Craig Kennedy, Assistant Director
Mining and Reclamation Division

RE: BARITE HILL PROJECT - ACID LEACHATE TREATABILITY STUDY AND SEDIMENT CONTROL

Dear Craig,

As requested, a mass balance has been conducted on acid leachate from the waste rock versus the neutralizing capability of the limestone and the expected "life" of the limestone. The mass balance is based on the results of the acid production potential tests as summarized in the D. P. Engineering, Inc. (DPEI) letter dated October 30, 1989 and the humidity cell tests summarized in the DPEI letter dated January 19, 1990, and the specification of the limestone have a $CaCO_3$ equivalent of 90 percent.

WASTE AREA A

1,305

100 percent Rainsford Pit Waste Rock
Acid Producing Rock = 832 Tons (use 900 tons)
Acidity of Leachate = 16 mg/l = 43.5 lb/ac-ft
Infiltration at 50 percent precipitation = 30 ac-ft/yr
Annual Rate = 1,305 lb/yr
Total Life = 900 tons/1,305 lb/yr - 1,380 yrs
Available Limestone per Design = 2,000 tons minimum
Reactive Limestone at 90 percent = 1,800 tons

WASTE AREA B

100 percent Main Pit Waste Rock
Acid Producing Rock = 443 tons (use 500 tons)
Acidity of Leachate = 16 mg/l - 43.5 lb/ac-ft
Infiltration at 50 percent precipitation = 50 ac-ft/yr
Annual Rate = 2,175 lb/yr
Total Life = 500 tons/2,175 lb/yr = 460 yrs
Available Limestone per Design = 1,500 tons minimum
Reactive Limestone at 90 percent = 1,350 tons

Based on a one-to-one ratio of acid generation and neutralization, adequate limestone is available to react with the acid leachate. Also, these calculations assume that the acid producing rock is evenly dispersed throughout the waste dump and that the infiltration is uniform over the surface of the dump.

Gwalia understands that all runoff from disturbed areas has to be either contained or routed through one of the NPDES discharge points. We are aware of your particular concerns on this around the plant area and ore stockpile area at the crusher. The plant area is to be graded to drain into the solution ponds. Runoff from the ore stockpile area will be diverted through Waste Area A. The ditch alignment will be field located based on area grading during construction. These items will be shown in the as-built plans prior to receiving notice to proceed with mining.

I hope the above information is sufficient to complete your review of the Barite Hill Mine application for operation. If you should have any questions or require additional information, please call me.

Sincerely,

D. P. ENGINEERING, INC.

Don A. Poulter, P.E.
Project Principal

DAP/rkj

D. P. ENGINEERING, INC.

7125 W. JEFFERSON AVE., SUITE 300
LAKEWOOD, CO 80235

TEL: 303-980-0679
FAX: 303-985-0439

January 19, 1990
Project No. 00701

South Carolina Land Resources Conservation Commission
2221 Devine Street, Suite 222
Columbia, South Carolina 29205

Attention: Mr. Craig Kennedy, Assistant Director
Mining and Reclamation Division

RE: WASTE ROCK ACID GENERATION POTENTIAL - HUMIDITY CELL TEST RESULTS

Dear Craig,

The humidity cell tests have been completed on the selected samples of waste rock. The purpose of the humidity cell tests were to evaluate the potential for the generation of acid leachate from the waste rock. In addition, selected effluent samples were analyzed for heavy metals with respect to NPDES effluent discharge limitations. The results are discussed in the following paragraphs. The test results are presented in Attachment 1.

At the start of the test work, it was believed that the samples were representative of the waste rock within the mine plan. It was later realized that seven of the samples used in the tests were from areas outside the planned pit limits. Therefore, the presence of pyrite in the waste rock may have been over estimated in the original acid production potential tests. This was addressed in a letter to you dated October 30, 1989. A copy of the letter is attached for reference.

Humidity cell tests were run on three composite samples. The composite samples are listed on Table 1. The test results show that the waste rock from the main pit will probably not produce acid leachate in the long-term, however, the possibility for local "hot spots" does exist. The waste rock from the Rainsford pit may be an acid producing material as the pH was still decreasing at the close of the tests.

Effluent from the humidity cell tests was analyzed for heavy metals with respect to compliance with the NPDES discharge limitations. The effluent from Week 8 of the tests was selected as the representative effluent sample.

The pH values reported in Week 6 appear to be "worst case" however, it was found to be a laboratory error in preparing the leachate. The deionized water had a depressed pH prior to input into the humidity cell. The pH in Sample No. 2, Week 4, was also a laboratory error in recording the data.

The analytical results show the effluent to meet all NPDES discharge limitations except for copper. The copper values were 0.06 to 0.07 mg/l. The discharge limitation are set at <0.01 mg/l. Barium was analyzed for each sample each week and found to be less than the discharge standards. The effluent from Sample Nos. 1 and 2, Week 10, is being checked for copper values.

Tests are currently underway to check for pH control via the effluent passing through a limestone gravel drain prior to discharge. The effluent will also be checked to see what influence the pH adjustment may have on the dissolved copper in the effluent.

Means to mitigate the potential for acid leachate were discussed in the previous letters. In summary, rock with a high potential for acid generation (such as the felsic tuff in the Rainsford Pit) will be isolated within the dump areas to reduce exposure to acid generating conditions. In the event a suppressed pH is measured in the effluent, lime will be placed in the drainage ditches and infiltrations basin at the dump toe to adjust the pH to an acceptable level. Samples of the effluent will be collected to evaluate its characteristics and determine the level of treatment required to meet the NPDES standards during operation and following closure.

Based on the information to date coupled with the proposed inclusion of limestone in the toe of the dumps, we do not believe acid generation from the waste rock will have an impact on the environment. Therefore, revisions to the current waste dump plans are not believed necessary at this time in order to comply with the NPDES Permit limitations.

We hope this information is useful in allowing Gwalia (U.S.A.) Ltd. to proceed with the Barite Hill Project. Should the test results from the limestone treatment studies show cause to revise the waste dump plans, the proposed revision will be included with the data summary.

If you should have any further questions or require additional information, please call.

Sincerely,

D. P. ENGINEERING, INC.

Don A. Poulter, P.E.
Project Principal

DAP/rkj

Attachments

TABLE 1

COMPOSITE SAMPLE SUMMARY

COMPOSITE NUMBER	LAB NO.	BOREHOLE AND LOCATION*	LITHOLOGY	PERCENT WASTE ROCK
1	2	D27: 125-140-MP (O)	Medisediment	20%
1	14	D33: 105-120-MP (I)	Sulfide	<1%
2	17	D44: 40-60 RP (I)	Medisediments	50%
2	20	D42: 40-50 RP (I)	Felsic Tuff	35%
3	4	D8: 40-50 MP (I)	Felsic Tuff	48%
3	6	D40: 20-40 MP (I)	Felsic Tuff	48%
3	10	D24: 30-45 MP (I)	Mafic Dike	16%

* MP - Main Pit; RP - Rainsfor Pit
I - within pit plan; O - outside pit plan

ATTACHMENT 1

Western Atlas International

DOPE LABORATORIES

ANALYTICAL REPORT

891320

FOR

GWALIA (USA) LTD.

P.O. BOX 1510
McCORMICK, SC 29835

01/17/90

HUMIDITY CELL TESTING

INTRODUCTION

Analytical tests used to predict the formation of acid mine drainage fall into two categories. Static tests measure the amount of acid-producing material and acid-consuming material present in the sample. Kinetic testing attempts to simulate the acid-producing and acid-consuming processes which occur in the natural environment. Humidity cell testing is a kinetic test. Results obtained from static tests are relatively simple to interpret but may not be representative of the naturally occurring chemical reactions. Kinetic tests, including humidity cell testing, are a more realistic model of the reactions occurring in the natural environment but analytical results are often more difficult to interpret.

SAMPLE PREPARATION

Samples are air-dried at room temperature for 24 hours or until a stable weight is obtained. Air-dried samples are then crushed to minus 10 mesh (2 mm) using a disk pulverizer and thoroughly blended. Air-dried, crushed samples are stored in plastic bags until analysis.

TEST APPARATUS

Humidity test cells are plastic containers with tight-fitting lids. Each cell is 2.75 inches high and 7 inches square. An air inlet feeds into the center of the top lid and a drain fitting is located in the bottom corner of each cell (see Figure 1). A series of twelve individual humidity cells is connected to a regulated source of compressed air using equal lengths of 0.5 inch diameter Tygon tubing. Humidified air is generated using a 6.5 gallon glass carboy which is half-filled with deionized water. This carboy is equipped with Tygon tubing connected to two dispersion air-stones. Compressed air can be fed directly to the humidity cells (dry air cycle) or pumped through the carboy first and then routed to the humidity cells (humidified air cycle). Humidity cells are placed on wire racks during testing. Sample leachates are collected using glass beakers located beneath the drain fitting of each cell (see Figure 1).

TEST PROCEDURE

Humidity cell tests can be run on groups of up to twelve samples. A representative 200.0 gram portion of the air-dried, minus 10 mesh sample is placed in each cell. Cells are then sealed and air-line hoses are securely fastened. Testing consists of a seven day cycle which is repeated for a total of eight to ten weeks, depending on client needs. Each weekly cycle starts by feeding dry air to the humidity cell for three days. Humidified air is then fed to each cell on days four through six. On day seven, 200 mls of deionized water is added to each cell and allowed to soak for one hour. After one hour, the sample leachate is drained into the collection beaker. Sample leachates are 0.45um filtered and analyzed for pH, conductivity, sulfate, iron and acidity. Additional parameters can be analyzed, if requested, although sample leachate volume is a limiting factor.

OPERATING SPECIFICATIONS

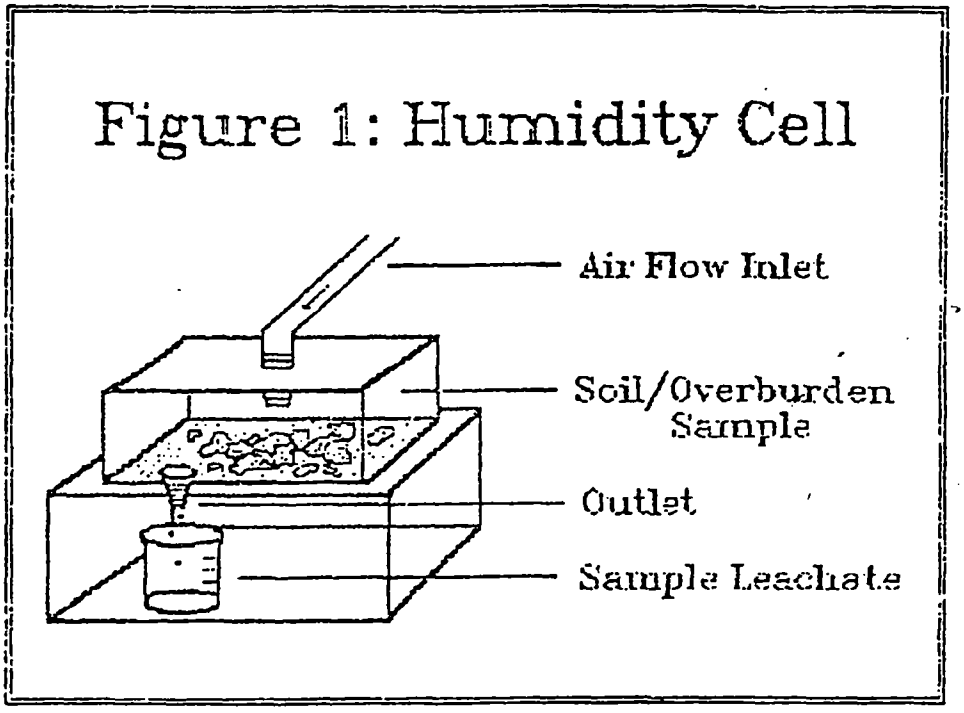
An air flow rate of five to eight liters per minute is maintained through each cell during both dry and humidified air cycles. Hose clamps are utilized to aid in equalizing flow rates. Approximately 110 to 150 mls of vaporized water pass through each cell during the three day humidified air cycle. Ambient temperatures range from 60 to 80 degrees fahrenheit during testing. Sample material is left undisturbed for the duration of testing.

ANALYTICAL RESULTS

Analytical results for weekly sample leachates generated from each humidity cell are reported using a standard format. In addition, graphs of appropriate analytical results versus time (normally pH, cumulative sulfate and cumulative acidity) are also reported.

DISCUSSION

Kinetic testing used to predict acid mine drainage is a relatively new concept. Humidity cell testing is designed to measure the rate of oxidation and weathering of various soils, rock and overburden samples. The normal operating specifications described above can be modified to best match a particular environment. Analytical results can also be reported in a format which better meets the needs of the project or client.



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Ferguson, K.D., Static and Kinetic Methods to Predict Acid Mine Drainage, Department of the Environment, Environmental Protection Service, Pacific Region, July 1985.

Skousen, J.G., Sencindiver, J.C. and Smith, R.M., A Review of Procedures for Surface Mining and Reclamation in Areas With Acid Producing Materials, Division of Plant and Soil Sciences, College of Agriculture and Forestry, West Virginia University, Morgantown, West Virginia, April 1987, pp. 3-8.

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Western Atlas International

CORE LABORATORIES

SUMMARY OF DATA GENERATED FROM HUMIDITY CELL TESTING
GWALIA (USA) LTD.
January 17, 1990

CLIENT SAMPLE I.D.: BARITE HILL/SOIL COMPOSITES(BHD 27,125-140' & BHD 33,105-120')
LAB SAMPLE I.D.: 891320-1 (Composite Of 891224-2 & 891224-14)

PARAMETER	UNITS	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10
Leachate Quantity	mls	138	130	129	128	131	129	160	134	140	142
pH	pH Units	5.30	5.27	5.31	5.10	5.06	4.84	5.19	5.17	5.27	5.68
Conductivity	umohs/cm	56	84	117	68	64	60	36	37	38	43
Sulfate	mg/L	18	24	29	22	22	15	18	15	15	14
Cumulative Sulfate	Total mg	2	6	9	12	15	17	20	22	24	26
Acidity	mg/L CaCO3	14	<10	10	10	10	<10	<10	<10	16	<10
Cumulative Acidity	Tot. mg CaCO3	2	2	3	5	6	6	6	6	8	8
Iron (Diss.)	mg/L	2.41	0.04	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cumulative Iron	Total ug	333	338	338	338	338	338	338	338	338	338
Barium	mg/L	0.15	0.14	0.12	0.12	0.11	0.14	0.17	0.12	0.15	0.13
Cumulative Barium	Total ug	21	39	54	70	84	102	129	145	166	185
Nickel	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04					

CLIENT SAMPLE I.D.: BARITE HILL/SOIL COMPOSITES(BHD 44,40-60' & BHD 42,40-50')
LAB SAMPLE I.D.: 891320-2 (Composite Of 891224-17 & 891224-20)

PARAMETER	UNITS	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10
Leachate Quantity	mls	137	145	114	155	151	132	136	145	144	142
pH	pH Units	5.37	5.31	5.18	6.44	5.25	4.93	5.15	5.08	4.69	4.29
Conductivity	umohs/cm	45	94	63	12	37	39	36	28	27	26
Sulfate	mg/L	16	33	16	10	11	10	11	11	<10	<10
Cumulative Sulfate	Total mg	2	7	9	10	12	13	15	16	16	16
Acidity	mg/L CaCO3	12	14	12	<10	<10	<10	<10	<10	15	<10
Cumulative Acidity	Tot. mg CaCO3	2	4	5	5	5	5	5	5	7	7
Iron (Diss.)	mg/L	2.84	0.04	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cumulative Iron	Total ug	389	395	395	395	395	395	395	395	395	395
Barium	mg/L	0.10	0.07	0.07	<0.01	0.08	0.08	0.07	0.06	0.10	0.10
Cumulative Barium	Total ug	14	24	32	32	44	54	64	73	87	101
Nickel	mg/L	<0.04	0.05	0.04	<0.04	<0.04					

Western Atlas International

CORE LABORATORIES

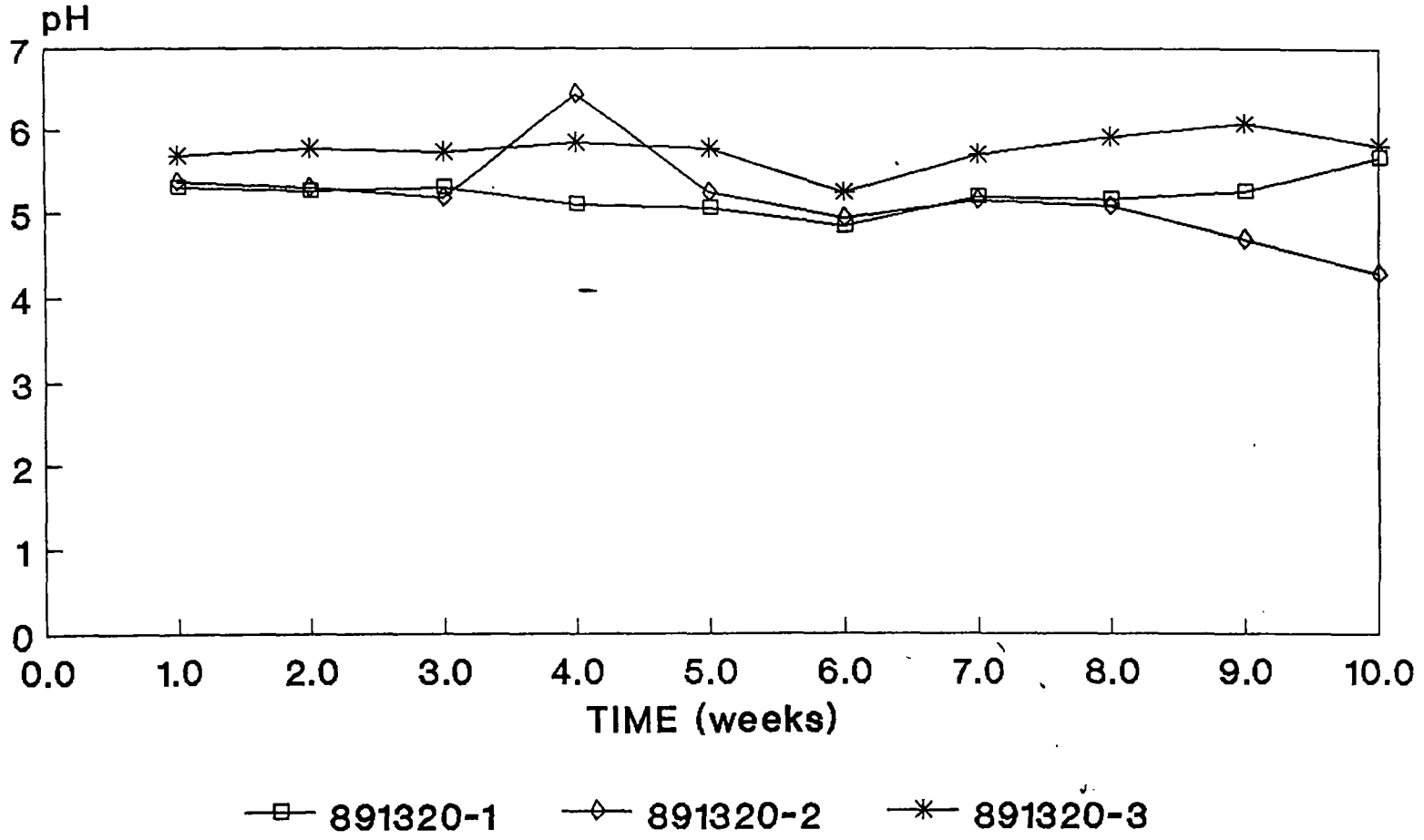
SUMMARY OF DATA GENERATED FROM HUMIDITY CELL TESTING
GWALIA (USA) LTD.
January 17, 1990

CLIENT SAMPLE I.D.: BARITE HILL/SOIL COMPOSITES(BHD 8,40-50',BHD 40,20-40' & BHD 24,30-45')
LAB SAMPLE I.D.: 891320-3 (Composite Of 891224-4, 891224-6 & 891224-10)

PARAMETER	UNITS	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10
Leachate Quantity	mls	104	110	112	121	118	102	102	139	127	112
pH	pH Units	5.69	5.77	5.73	5.84	5.77	5.25	5.71	5.91	6.08	5.81
Conductivity	umohs/cm	34	64	48	31	30	34	25	17	19	17
Sulfate	mg/L	<10	<10	<10	12	<10	11	13	<10	<10	<10
Cumulative Sulfate	Total mg	0	0	0	1	1	3	4	4	4	4
Acidity	mg/L CaCO3	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cumulative Acidity	Tot. mg CaCO3	0	0	0	0	0	0	0	0	0	0
Iron (Diss.)	mg/L	0.27	<0.03	0.05	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Cumulative Iron	Total ug	28	28	34	34	34	34	34	34	34	34
Barium	mg/L	0.13	0.09	0.09	0.06	0.04	0.04	0.04	0.03	0.07	0.06
Cumulative Barium	Total ug	14	23	34	41	45	50	54	58	67	73
Nickel	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04					

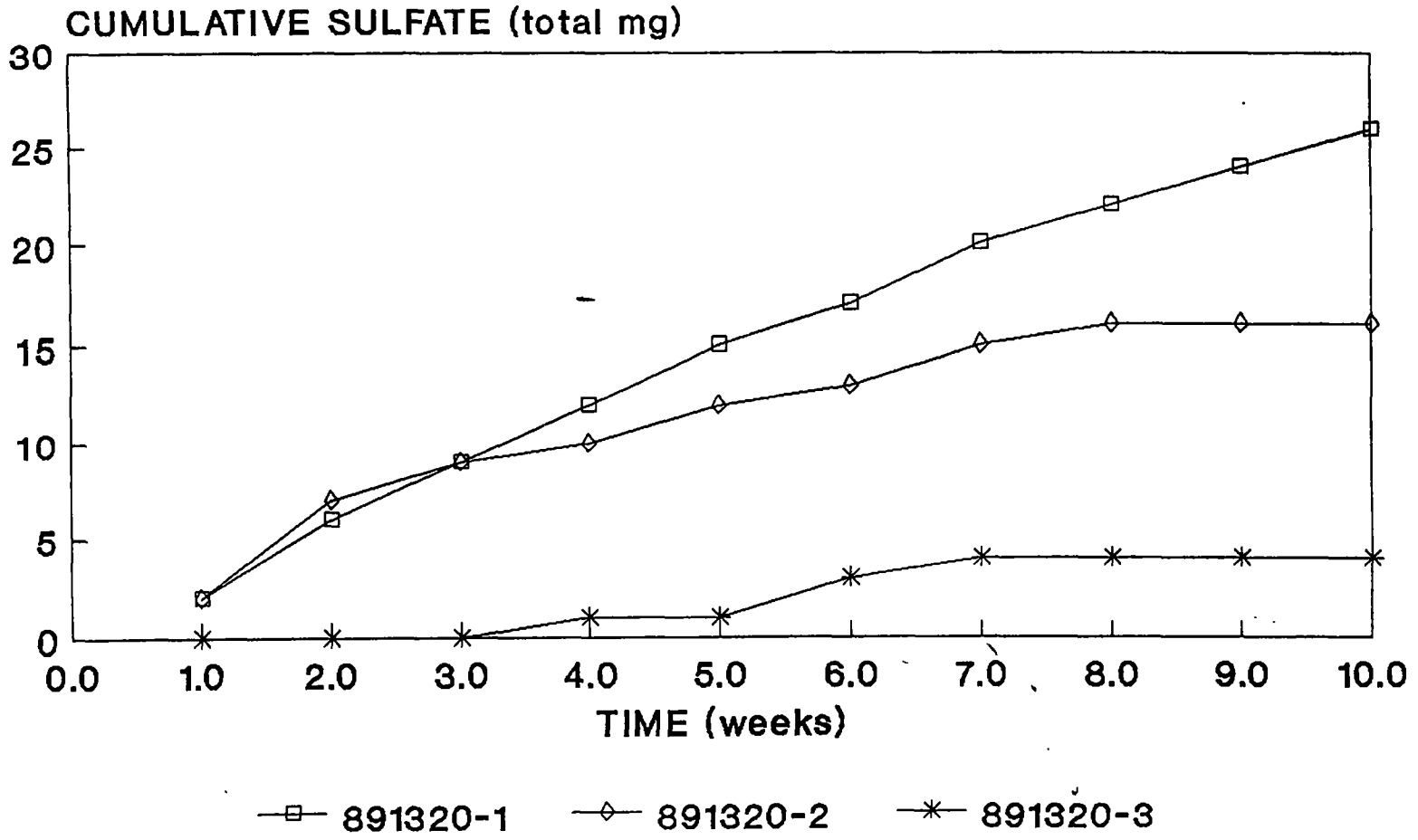
HUMIDITY CELL TESTS

pH of Barite Hill Sample Leachates



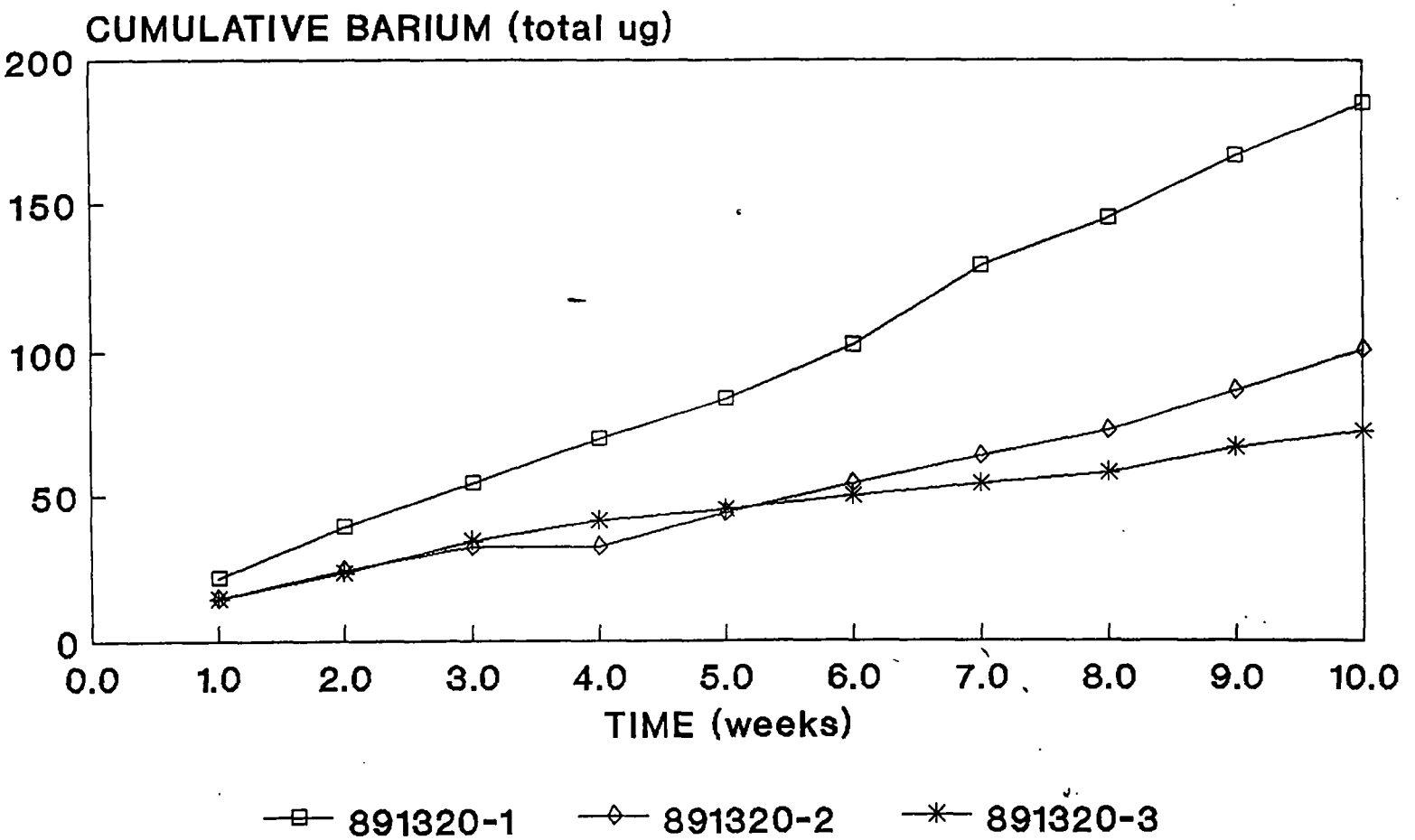
HUMIDITY CELL TESTS

Cumulative Sulfate-Barite Hill Samples



HUMUDITY CELL TESTS

Cumulative Barium-Barite Hill Samples



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CORE LABORATORIES

LABORATORY TESTS RESULTS
01/08/90

JOB NUMBER: 891320 CUSTOMER: GWALIA (USA) LTD. ATTN:

SAMPLE NUMBER: 25 DATE RECEIVED: 12/18/89 TIME RECEIVED: 13:38 SAMPLE DATE: 12/18/89 SAMPLE TIME: 13:38
PROJECT: HUMIDITY CELLS SAMPLE: HCT WEEK 8 REM: COMP. 891224(2,14)

SAMPLE NUMBER: 26 DATE RECEIVED: 12/18/89 TIME RECEIVED: 13:38 SAMPLE DATE: 12/18/89 SAMPLE TIME: 13:38
PROJECT: HUMIDITY CELLS SAMPLE: HCT WEEK 8 REM: COMP. 891224(17,20)

SAMPLE NUMBER: 27 DATE RECEIVED: 12/18/89 TIME RECEIVED: 13:38 SAMPLE DATE: 12/18/89 SAMPLE TIME: 13:38
PROJECT: HUMIDITY CELLS SAMPLE: HCT WEEK 8 REM: COMP. 891224(4,6,10)

TEST DESCRIPTION	SAMPLE 25	SAMPLE 26	SAMPLE 27				UNITS OF MEASURE
Acidity (Filt.)	<10	<10	<10				mg/L CaCO3
Conductivity (Filt.)	37.1	28.5	16.6				umhos/cm @25oF
pH (Filt.)	5.17	5.08	5.91				pH Units
Sulfate (Filt.)	15	11	<10				mg/L
Arsenic, Diss. (As)	<0.01	<0.01	<0.01				mg/L
Barium, Diss. (Ba)	0.12	0.06	0.03				mg/L
Cadmium, Diss. (Cd)	<0.005	<0.005	<0.005				mg/L
Chromium, Diss. (Cr)	<0.01	<0.01	<0.01				mg/L
Copper, Diss. (Cu)	0.06	0.07	<0.01				mg/L
Iron, Diss. (Fe)	<0.03	<0.03	<0.03				mg/L
Lead, Diss. (Pb)	<0.05	<0.05	<0.05				mg/L
Mercury, Diss. (Hg)	<0.0003	<0.0003	<0.0003				mg/L

APPROVED BY: David McWhorter

1300 S. Potomac St., Suite 130
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(303) 751-1780

Western Atlas International

CORE LABORATORIES

LABORATORY TESTS RESULTS
01/08/90

I NUMBER: 891320 CUSTOMER: GWALIA (USA) LTD. ATTN:

SAMPLE NUMBER: 25 DATE RECEIVED: 12/18/89 TIME RECEIVED: 13:38 SAMPLE DATE: 12/18/89 SAMPLE TIME: 13:38
PROJECT: HUMIDITY CELLS SAMPLE: HCT WEEK 8 REM: COMP. 891224(2,14)

SAMPLE NUMBER: 26 DATE RECEIVED: 12/18/89 TIME RECEIVED: 13:38 SAMPLE DATE: 12/18/89 SAMPLE TIME: 13:38
PROJECT: HUMIDITY CELLS SAMPLE: HCT WEEK 8 REM: COMP. 891224(17,20)

SAMPLE NUMBER: 27 DATE RECEIVED: 12/18/89 TIME RECEIVED: 13:38 SAMPLE DATE: 12/18/89 SAMPLE TIME: 13:38
PROJECT: HUMIDITY CELLS SAMPLE: HCT WEEK 8 REM: COMP. 891224(4,6,10)

T	T DESCRIPTION	SAMPLE 25	SAMPLE 26	SAMPLE 27				UNITS OF MEASURE
	Selenium, Diss. (Se)	0.01	0.02	<0.01				mg/L
	Zinc, Diss. (Zn)	0.01	0.02	0.01				mg/L

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D. P. ENGINEERING, INC.

7125 W. JEFFERSON AVE., SUITE 300
LAKEWOOD, CO 80235

TEL: 303-980-0679
FAX: 303-985-0439

October 30, 1989
Job No. 00701

State of South Carolina
Land Resources Conservation Commission
Division of Mining and Reclamation
2221 Devine Street, Suite 222
Columbia, SC 29205

Attn: Mr. Craig Kennedy
Assistant Director

Re: Barite Hill Project, McCormick County
Waste Rock Acid Production Potential

Dear Craig:

This letter is in followup with the September 27, 1989 letter which presented the initial acid/base accounting test results.

Account testing of the acid production potential (APP) of the waste rock from the Barite Hill mine pits has been completed. A total of 21 samples were tested for APP and acid neutralizing potential (ANP). The APP considered both total sulfur and sulfur reactive with peroxide. Appendix A presents a summary of the data in terms APP with respect to the percent sulfur present that reacts with peroxide and a full summary of the test data.

The samples were selected to represent the lithologies in the mine areas and the visual log of percent pyrite present within each lithology. A second review of the sample locations found that several were beneath the limits of the proposed pits and probably over emphasize the sulphide bearing lithologies at the deeper levels.

In order to estimate the overall APP, it was necessary to estimate the approximate percentages of different waste rocks in both pits (Table 1). This estimate was made using the geological models developed by BP using diamond drill data, with the relative percentages being calculated from the proportion of assays in each lithology--excluding ore. From this, the tonnage of waste of each lithology was calculated.

The net APP for each sample was taken as the difference between the APP/peroxide (tons $CaCo_3$/Kt) and the acid neutralizing potential (ANP), with the latter representing the ability of the rock itself to neutralize acid. The average APP or ANP for each rock type was calculated to estimate the overall APP or ANP of a particular lithology. These results are presented in Table 2.

Main Pit

The results indicate that quartz porphyry, mafic intrusives and baritic material have positive ANP, whereas some of the felsic tuff and metasediments are negative. In fact, geological description confirms that negative ANP only occurs in visually pyritic lithologies. From this point of view, the samples are not truly representative since the sample depth range is 30 - 135' and most samples coming from > 85', i.e., the uppermost heavily oxidized section of the deposit is very much under-represented. For this reason, it was decided to consider 1/2 of the metasediments and 3/1 of the felsic tuff to be unsampled and that the ANP of these unsampled rocks would be neutral. (This is probably a conservative approach, since evidence suggests that wholly oxidized rocks are ANP positive.)

The net effect of the waste rock seems to be ANP negative, i.e., the waste could produce acid (but only if all sulphide were oxidized), to the equivalent of 443 tons of $CaCo_3$. This amount has been more than taken care of in the toe of waste dumps which contain 1000 and 2500 tons limestone respectively.

RAINSFORD PIT

The same approach has been used to quantify ANP here, although it must be noted that sample depths range from 40 to 120' and that samples:

BHD 16 (85 - 100')
BHD 43 (105 - 120')
BHD 19 (85 - 90')

all lie beneath the proposed pit and well within the sulphide zone.

The APP/ANP values for mafic and porphyry intrusives were taken from the Main Pit where the rocks are essentially identical.

In order to allow for the non-representative sampling, we considered that the results of the felsic tuffs only represent 1/3 of the total felsic rock waste, the remainder being shallower and more oxidized, i.e., APP neutral. On this basis, ANP is - 832 i.e., 832 tons of limestone would be required to neutralize the total acid producing potential.

CONCLUSIONS

Both the Main and Rainsford Pits have potential to create acid in small amounts, if all of the APP/peroxide is oxidized. However, these amounts are compensated for by the presence of limestone at the toe of the dumps. Also, the infiltration of rainwater through the dump should provide some dilution/buffering to the infiltration passing through the waste rock.

Means to mitigate the potential for acid leachate were discussed in the previous letter. To further mitigate the potential for acid generation, rock with a high potential for acid generation (such as the felsic tuff in the Rainsford Pit) will be isolated within the dump areas to reduce exposure to acid generating conditions.

In the event a suppressed pH is measured in the effluent, lime will be placed in the drainage ditches and infiltration basin at the dump toe to adjust the pH to an acceptable level. Samples of the effluent will be collected to evaluate its characteristics and determine the level of treatment required to meet the NPDES standards during operation and following closure.

Humidity cell tests are ongoing on three composite samples to further evaluate the reactivity of the pyrite in the waste rock. To date, the results show that the pH may be depressed to as low as 5.3 with conductivity of the effluent being less than 60 umho/cm. The composite samples being tested as: 1) #2 and #14, 2) #17 and #20, and 3) #4, #6, and #10. The composite sample is based on equal weights of each rock sample.

Based on the information to date coupled with the proposed inclusion of limestone in the toe of the dumps, we do not believe acid generation from the waste rock will be an impact to the environment.

We hope this information is useful in allowing Gwalia (U.S.A.) Ltd. to proceed with the Barite Hill Project. Additional summary reports will be provided as subsequent humidity cell data becomes available. Should the test results show cause to revise the waste dump plans, the proposed revision will be included with the data summary.

If you should have any further questions or require additional information, please call.

Sincerely,

D.P. ENGINEERING, INC.

Don A. Poulter, P.E.
Project Manager

DAP:ct
enclosures

TABLE 1 - PERCENTAGE OF WASTE LITHOLOGIES

Lithology	Main Pit	Rainsford Pit
Metasediments	27.0% = 459,000 tons	50.0% = 116,000 tons
Felsic tuffs	47.6% = 809,200 tons	35.2% = 81,644 tons
Quartz porphyry	7.4% = 125,800 tons	13.1% = 30,392 tons
Mafic intrusive	15.7% = 266,900 tons	1.7% = 3,944 tons
Baritic Rock	2.3% = 39,100 tons	
Total Waste Rock	1.7×10^6 tons	0.232×10^6 tons

TABLE 2 - AVERAGE ACID NEUTRALIZING POTENTIAL

Average Acid Neutralizing Potential (ANP) Values for Waste Lithologies (from results, Appendix A).

Lithology	Main Pit	Rainsford Pit
*Metasediment	-2.6	+ 0.1
*Felsic tuff	-1.4	-35.0
Quartz porphyry	+3.4	
Mafic intrusive	+1.6	
Baritic rock	+0.9	

*See text for estimate of proportion of such material present.
(-) = acid
(+) = basic
Results reported as tons $CaCO_3$ per Kt of waste rock.

APPENDIX A ANALYTICAL REPORT : BARITE HILL : WASTE ROCK ACID PRODUCING POTENTIAL

(I) MAIN ZONE

SAMPLE NO.	DRILL HOLE	DEPTH	LITHLOLOGY	APP/PEROX %SULFUR	APP/PEROX t CaCo3/kT	ANP t CaCo3/KT	NET ANP
1	D25	85-100'	METASEDIMENT	<.01	<0.1	4.4	+4.4
2	D27	125-140'	METASEDIMENT, PYRITIC	0.39	12.2	<0.1	-12.2
3	D3	120-135'	METASEDIMENT	<.01	<0.1	<0.1	-
4	D8	40-50'	FELSIC TUFF	0.06	1.8	4.2	+2.4
5	D27	105-120'	FELSIC TUFF	<.01	<0.1	<0.1	-
6	D40	20-40'	FELSIC TUFF, PYRITIC	0.25	7.9	1.2	-6.7
7	D25	50-65'	BARITIC, PYRITIC	0.16	4.9	6.2	+1.3
8	D27	85-95'	BARITIC	<.01	<0.1	<0.1	-
9	D30	35-45'	BARITIC	<.01	<0.1	1.4	+1.4
10	D24	30-45'	MAFIC	<.01	<0.1	1.5	+1.5
11	C16	70-85'	MAFIC	<.01	<0.1	<0.1	-
12	D7	60-70'	MAFIC	<.01	<0.1	3.3	+3.3
13	D2	110-120'	SULFIDE	<.01	<0.1	0.4	+0.4
14	D33	105-120'	SULFIDE	<.01	<0.1	1.6	+1.6
15	D39	115-135'	PORPHYRY	<.01	<0.1	3.6	+3.6
16	D48	65-80'	PORPHYRY	0.02	0.8	4.0	+3.2

(II) RAINSFORD ZONE

SAMPLE NO.	DRILL HOLE	DEPTH	LITHLOLOGY	APP/PEROX %SULFUR	APP/PEROX t CaCo3/kT	ANP t CaCo3/KT	NET ANP
17	D44	40-60'	METASEDIMENT	0.02	0.8	0.7	-0.1
18	D16	85-100'	METASEDIMENT, PYRITIC	0.28	8.6	0.7	-7.9
19	D43	105-120'	FELSIC TUFF, PYRITIC	1.80	56.1	5.7	-50.4
20	D42	40-50'	FELSIC TUFF, PYRITIC	1.32	41.2	0.2	-41.0
21	D19	85-90'	FELSIC TUFF, PYRITIC	1.46	45.7	5.0	-40.7

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CORE LABORATORIES

A N A L Y T I C A L R E P O R T

891224

FOR

GWALIA (USA) LTD.

P.O. BOX 1510
McCORMICK, SC 29835

10/11/89

Western Atlas International
A Dresser Company

CORE LABORATORIES

LABORATORY TESTS RESULTS
10/11/89

JOB NUMBER: 891224 CUSTOMER: GWALIA (USA) LTD. ATTN:

SAMPLE NUMBER: 1 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 25 85-100' REM:

SAMPLE NUMBER: 2 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 27 125-140' REM:

SAMPLE NUMBER: 3 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 3 120-135' REM:

SAMPLE NUMBER: 4 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 8 40-50' REM:

SAMPLE NUMBER: 5 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 27 105-120' REM:

SAMPLE NUMBER: 6 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 40 20-40' REM:

TEST DESCRIPTION	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	SAMPLE 6	UNITS OF MEASURE
Total Sulfur (%)	0.46	0.80	0.05	0.38	0.02	0.72	%
PP/Peroxide (% Sulfur)	<0.01	0.39	<0.01	0.06	<0.01	0.25	%
Total Sulfur (Tons CaCO3/Kt)	14.4	25.0	1.6	11.9	0.6	22.5	Tons CaCO3/Kt
PP/Peroxide (Tons CaCO3/Kt)	<0.1	12.2	<0.1	1.8	<0.1	7.9	Tons CaCO3/Kt
Acid Neutralizing Potential	4.4	<0.1	<0.1	4.2	<0.1	1.2	Tons CaCO3/Kt

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10/11/89

JOB NUMBER: 891224 CUSTOMER: GWALIA (USA) LTD: ATTN:

SAMPLE NUMBER: 7 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 10/04/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 25 50-65' REM:

SAMPLE NUMBER: 8 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 27 85-95' REM:

SAMPLE NUMBER: 9 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 30 35-45' REM:

SAMPLE NUMBER: 10 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 24 30-45' REM:

SAMPLE NUMBER: 11 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: C16 70-85' REM:

SAMPLE NUMBER: 12 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 7 60-70' REM:

TEST DESCRIPTION	SAMPLE 7	SAMPLE 8	SAMPLE 9	SAMPLE 10	SAMPLE 11	SAMPLE 12	UNITS OF MEASURE
Total Sulfur (%)	2.39	1.07	4.07	0.03	0.03	0.01	%
APP/Peroxide (% Sulfur)	0.16	<0.01	<0.01	<0.01	<0.01	<0.01	%
Total Sulfur (Tons CaCO3/Kt)	74.7	33.4	127	0.9	0.9	0.3	Tons CaCO3/Kt
APP/Peroxide (Tons CaCO3/Kt)	4.9	<0.1	<0.1	<0.1	<0.1	<0.1	Tons CaCO3/Kt
Acid Neutralizing Potential	6.2	<0.1	1.4	1.5	<0.1	3.3	Tons CaCO3/Kt

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JOB NUMBER: 891224 CUSTOMER: GWALIA (USA) LTD ATTN:

SAMPLE NUMBER: 13 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 2 110-120' REM:

SAMPLE NUMBER: 14 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 33 105-120' REM:

SAMPLE NUMBER: 15 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 39 115-135' REM:

SAMPLE NUMBER: 16 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 48 65-80' REM:

SAMPLE NUMBER: 17 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 44 40-60' REM:

SAMPLE NUMBER: 18 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 16 85-100' REM:

TEST DESCRIPTION	SAMPLE 13	SAMPLE 14	SAMPLE 15	SAMPLE 16	SAMPLE 17	SAMPLE 18	UNITS OF MEASURE
Total Sulfur (%)	2.64	1.40	<0.01	0.18	0.23	1.52	%
APP/Peroxide (% Sulfur)	<0.01	<0.01	<0.01	0.02	0.02	0.28	%
Total Sulfur (Tons CaCO3/Kt)	82.5	43.8	<0.3	5.6	7.2	47.5	Tons CaCO3/Kt
APP/Peroxide (Tons CaCO3/Kt)	<0.1	<0.1	<0.1	0.8	0.8	8.6	Tons CaCO3/Kt
Acid Neutralizing Potential	0.4	1.6	3.6	4.0	0.7	0.7	Tons CaCO3/Kt

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LABORATORY TESTS RESULTS
10/11/89

JOB NUMBER: 891224 CUSTOMER: GUALIA (USA) LTD. ATTN:

SAMPLE NUMBER: 19 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 43 105-120' REM:

SAMPLE NUMBER: 20 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 42 40-50' REM:

SAMPLE NUMBER: 21 DATE RECEIVED: 09/18/89 TIME RECEIVED: 16:30 SAMPLE DATE: 09/14/89 SAMPLE TIME: 00:00
PROJECT: BARITE HILL PROJECT SAMPLE: BHD 19 85-90' REM:

TEST DESCRIPTION	SAMPLE 19	SAMPLE 20	SAMPLE 21				UNITS OF MEASURE
Total Sulfur (%)	4.63	2.94	8.27				%
APP/Peroxide (% Sulfur)	1.80	1.32	1.46				%
Total Sulfur (Tons CaCO3/Kt)	145	91.9	258				Tons CaCO3/Kt
APP/Peroxide (Tons CaCO3/Kt)	56.1	41.2	45.7				Tons CaCO3/Kt
Acid Neutralizing Potential	5.7	0.2	5.0				Tons CaCO3/Kt

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SAMPLES SUBMITTED FOR ACID GENERATION TESTS

AVG LITHOLOGY

TYPE 1 - METASEDIMENTS

	BHD 25	85-100 (I)		BHD 3	120-135 (O)
(1)	BHD 27	125-140 (O) (2)			

TYPE 2 - FELSIC TUFF

(3)	BHD 08	40-50 (I) (4)		BHD 27	105-120 (O)
	BHD 40	20-40 (I) (5)			

TYPE 7 - BARITE RICH

	BHD 25	50-65 (I)		BHD 30	35-45 (I)
	BHD 27	85-95 (I)			

TYPE 4 - MAFIC DIKE

(9)	BHD 24	30-45 (I) (10)
	C16	70-85 (I)
	BHD 07	60-70 (I)

TYPE 5 - SULFIDE

(1)	BHD 33	105-120 (I) (14)		BHD 2	110-120 (I)

TYPE 3 - QTZ. PORPHYRY

	BHD 39	115-135 (O)
	BHD 48	65-80 (I)

RNS LITHOLOGY

METASEDIMENTS	(4)	BHD 44	40-60 (I) (11)
		BHD 16	85-100 (O)
FELSIC TUFF		BHD 43	105-120 (O)
	(12)	BHD 42	40-50 (I) (20)
		BHD 19	85-90 (O)

I = In Pit Limits

O = Out of Pit Limits